1921

Flotation tests on a table sludge from the Golden Rod Milling Company at Tar River, Oklahoma

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Department:

FLOTATION TESTS ON A TABLE SLUDGE FROM THE GOLDEN ROD MILLING COMPANY AT TAR RIVER, OKLAHOMA.

BY

William H. Kamp.

A

THESIS

submitted to the faculty of the

SCHOOL OF MINES AND METALLURGY OF THE UNIVERSITY OF MISSOURI

in partial fulfillment of the work required for the

DEGREE OF

ENGINEER OF MINES IN MINE ENGINEERING

Rolla, Mo.

1921

Approved by Chas. J. Clayton.

Professor of Metallurgy and Ore Dressing.

FOREWORD

The author is indebted to Mr. M. H. Thornberry, Research Metallurgist of the Missouri State Experiment Station, for suggestions and encouragement during the progress of the work.

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INTRODUCTION

The purpose of this experimental work is to give to the operators of the Joplin District some facts concerning the possibilities of flotation in their district. An attempt will be made to show that high-grade concentrates can be made economically; also that the concentrate so made will be a distinct addition to that made by usual gravity concentration. It is believed that the oil and reagent used will not put a prohibitive cost burden upon the operators. It is, of course, realized that flotation concentrates of any zinc tenor bear a penalty because of the fineness of the product.

The sludge for these tests was obtained from the Golden Rod Mining and Smelting Corporation, Tar River, Oklahoma. The material was barreled wet and when received contained approximately 25 per cent moisture.

A portion of the sludge was taken, thoroughly mixed, and sampled. A chemical analysis of the sample gave the following results:

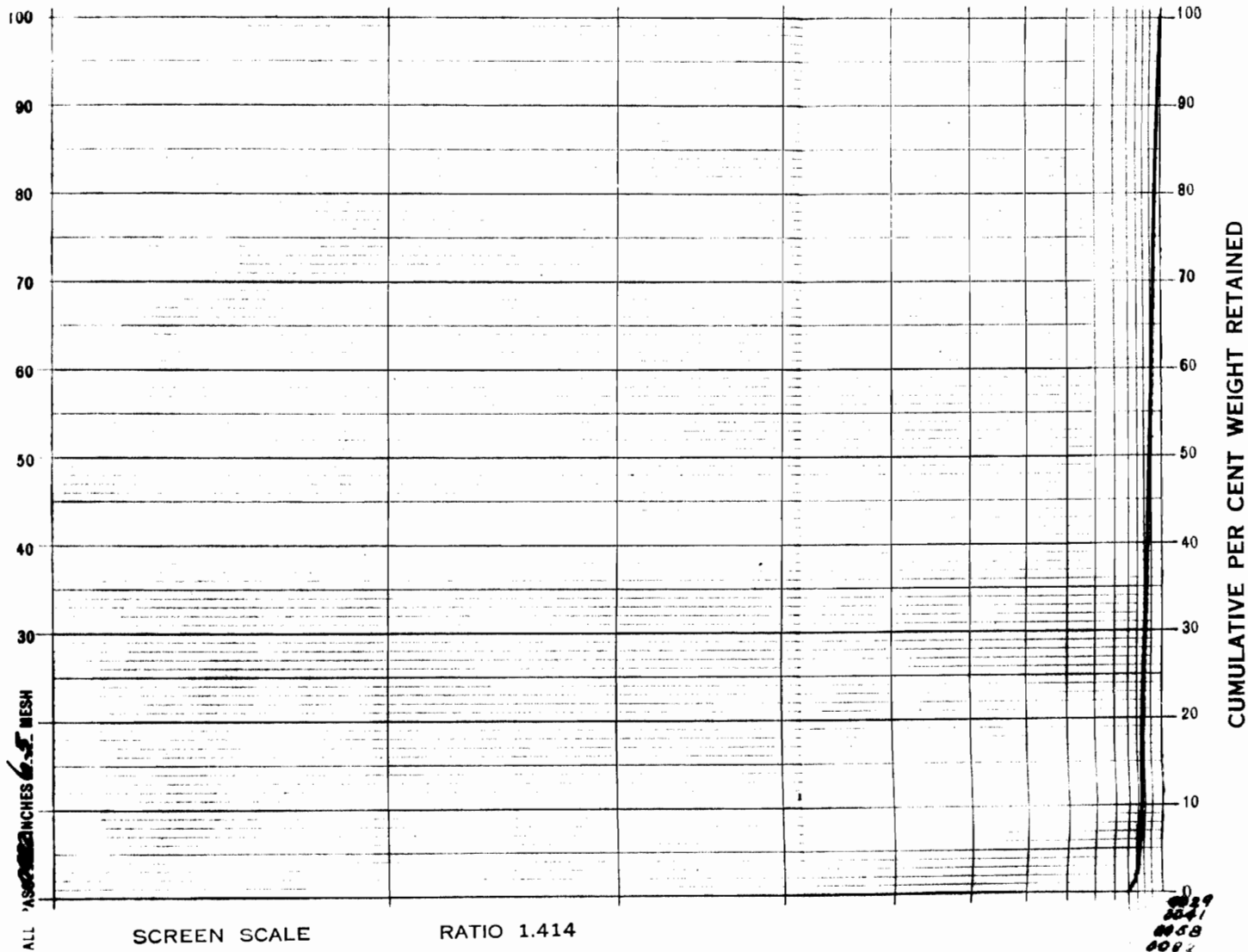
Zn	13.77
Fe	0.92
CaO	6.83
Pb	0.76
Insoluble	55.51

A screen analysis of the sludge was next made. The result of this analysis is shown on a separate sheet. It was found necessary to make this analysis on the wet material because when dried the screen openings were clogged, due to the fineness of the sludge.

The Tyler Standard Screen Scale

Cumulative Direct Diagram of Screen Analysis on Sample of Golden Rod Sludge

Name W. H. Kamp. **Date**



Indicate the Screen Crushed through and also First Retaining Screen

SCREEN SCALE RATIO 1.414

Openings Inches	Openings Millimeters	Mesh	Diameter Wire Inches	Sample Weights	Per Cent	Per Cent Cumulative Weights		% Total Zn on each screen ↓
1.050	26.67		.149					
.742	18.85		.135					
.525	13.33		.105					
.371	9.423		.092					
.263	6.680	3	.070					
.185	4.699	4	.065					
.131	3.327	6	.036					
.093	2.362	8	.032					
.065	1.651	10	.035					
.046	1.168	14	.025					
.0328	.833	20	.0172					
.0232	.589	28	.0125					
.0164	.417	35	.0122					
.0116	.295	48	.0092					
.0082	.208	65	.0072	gm.				
.0058	.147	100	.0042	9.28	2.25	2.25		0.43
.0041	.104	150	.0026	73.70	17.83	20.08		5.20
.0029	.074	200	.0021	124.50	30.13	50.21		20.61
.0029	.074	200	.0021	205.70	49.79	100.00		23.19
			Totals.					

All Pass
Retained In
"
"
Pass

THE W. S. TYLER COMPANY, CLEVELAND, OHIO

PRELIMINARY TESTS

A series of preliminary tests were next made for the purpose of ascertaining the oil or combination of oils and reagents best suited to float the blende in this sludge. In making these tests the weight of ore was approximated, placed in laboratory Janney flotation machine, and different oils and reagents added and the effect noted. The results of these preliminary tests are tabulated on pages 9 and 10 of this thesis.

In the preliminary tests the A. T. and X. Y. mixture from the Newport Chemical Company, Passiac, New Jersey, when used with copper sulphate produced such remarkable results that it was decided to confine the research work to the use of these oils and copper sulphate. The data on these final tests are recorded on special sheets, which are self explanatory.

CONDITION OF EXPERIMENTS

The tests were all made in a laboratory flotation machine of the Mineral Separation type. The method of conducting the experiments was as follows: A portion of the sludge was thoroughly mixed and the moisture determined. A charge of wet pulp containing approximately 700 grams of dry ore was weighed and poured into the machine with sufficient tap water to give the charge a dilution of five parts of water to one of dry ore, by weight. The machine was started and allowed to run until the charge was well mixed, after which a quantity of oil equivalent to 0.5 pound per ton of dry ore was added and the agitation continued. Copper sulphate was then added and the froth skimmed off. The froth when removed was divided into two portions and designated as concentrate and middling. The concentrate was that portion which was skimmed off as long as the froth appeared to be ladened with blende. The middling was removed after the concentrate and until apparently no more blende was carried up with the bubbles. The duration of each test was 15 to 20 minutes and the speed of the machine was 1700 r. p. m. The data on these tests are recorded on pages 11, 12 and 13 of this thesis.

Several charges were run to determine the minimum amount of copper sulphate necessary to float the blende in this sludge. It was found that this reagent produced the best results when added all at one time and after the oil had been added. The

results show that 70 cc of a one per cent solution of copper sulphate produced a very good concentrate and a good extraction. Seventy cubic centimeters of the copper sulphate solution means approximately two pounds of the reagent per ton of sludge treated.

CONCLUSIONS:

1. Copper sulphate is the main factor in the concentration of the blende in this sludge by flotation.

2. Either the A. T. mixture or the X. Y. mixture, or a combination of the two, in conjunction with copper sulphate, were the oils best suited to float the blende in this sludge.

3. From 50 cc to 70 cc of a one per cent solution of copper sulphate produced the best results.

4. Small amounts of copper sulphate added at intervals did not raise the blende as well as when added all at one time.

5. Another interesting factor is that the oil must be added first. When the copper sulphate was added to the charge before it was poured into the machine, practically no blende floated.

Machine: Janney

Experimenter: W. H. Kamp

ORE: Table Sludge from Golden Rod Mining and Smelting Co. Tar River, Okla. Zn = 13.77%

EXPERIMENT STATION

Missouri School of Mines and Metallurgy

FLOTATION LABORATORY.

OPERATING DATA

Time = 15 to 20 minutes
Ore = 700 grams
Water = 3500 grams.
Speed of Machine = 1700 RPM

Test No	OIL No.	OIL Amt. Drops	OIL Kind	REAGENTS Kind	REAGENTS Amt. cc	FROTH Kind	FROTH Amt.	REMARKS.	RESULTS Wt.	Per Ct.	Wt.	Per Ct	Wt.	Per Ct	Per Ct. Ext.
	19	5	Crude Pine oil												
1	117	5	Ref. Creosote	H_2SO_4	10	Wet		Fairly good Conc.	-	-	-	-	-	-	-
	128	5	5th. Pine Oil	-	-	Wet		Dirty Conc.	-	-	-	-	-	-	
2	117	5	Ref. Creosote	-	-	Wet		Good Conc.	-		-	-	-	-	
	127	5	Creosote	-	-	Dry		First Dirty and then cleaner	-	-	-	-	-	-	
3															
	130	5	Flot. Oil.	-	-	Dry		Not enough froth to make it run over	-	-	-	-	-	-	
4	117	5	Ref. Creosote	-	-	Wet		Better Conc.	-	-	-	-	-	-	
	A.T.	5	Mixture Newport Chem.	-	-	Wet		No Froth							
5	X.Y.	5	"	-	-	Wet		More Froth than without A.T. but not enough							
	A.T.	5	"	$CuSO_4$	Any	Dry		Very good looking Concentrate							
6															

Machine: Mineral Separation

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7	H.T.	5	Newport Chem. Wks.	$FeSO_4$	Any	Poor	-	No affect on Sphalerite							
	"	"	"	$CuSO_4$	Any	Poor		$FeSO_4$ must have had some affect on $CuSO_4$							
8	H.T.	5	"	$MnSO_4$	Any	"		No Conc.							
	19	5	Crude Pine Oil	$CuSO_4$	Any	Wet		Good Conc. but gangue with it.							
9															
	117	5	Ref. Creosote	$CuSO_4$	"	"		Good Conc, and more clean							
10															
	H.T.	5	Newport Chem. Wks.	$ZnSO_4$	"	Poor		Poor Conc.							
11				$CuSO_4$	"	Dry		Good Conc. immediately after adding $CuSO_4$							
	H.T.	10	"	$CuSO_4$	66			$CuSO_4$ added to ground & pitated. Put into machine and air added. No good.							
12								Then 25cc. $CuSO_4$ added and Zn came up immediately.		No analysis.					
	H.T.	5	"	$Pb(C_2H_3O_2)_2$				Lead Acetate added, but no good. Then $CuSO_4$ added & Zn formed immediately.							
13	X.Y.	5	"												

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Test No	OIL No.	OIL Amt. Drops	OIL Kind	REAGENTS Kind 1.84%	REAGENTS Amt. cc	Pounds $CuSO_4$	Pounds Oil	REMARKS.	RESULTS Conc Wt. gm.	RESULTS Conc Per Ct.	RESULTS Mids Wt. gm.	RESULTS Mids Per Ct	RESULTS Tail Wt. gm.	RESULTS Tail Per Ct	Per Ct. Ext.
	19	5	Crude Pine				.5								
1	117	5	Creosote	$CuSO_4$	70	2.1	.4	Better Conc. after adding #117	134	56.57			—	2.5	77.5
	A.T.	10	Newport Chem Wks.				1.0	Good Conc. Dry froth until all Zn is off, then wet. Brought over a							
2	117	1	Creosote	$CuSO_4$	50	1.5	.08	dirty Concentrate	128	58.53	34	46.93	—	0.88	93.0
	A.T.	5	Newport Chem Wks.				.5	$CuSO_4$ added 10 cc. at a time up to 60 cc.							
3	X.Y.	5	"	$CuSO_4$	60	1.8	.5	Good Concentrate after all $CuSO_4$ added	152	56.67	12	36.67		0.91	92.6
4	X.Y.	5	"	$CuSO_4$	60	1.8	.5	Good Conc. All $CuSO_4$ added at one time	124	59.16	45	39.47		0.66	94.0
5	A.T.	10	"	$CuSO_4$	30	0.9	1.0	Fairly good Conc, but not enough weight. Not enough $CuSO_4$ to bring up all Zn, therefore a poor extraction	48	54.70	39	41.44		8.12	44.0
6	A.T.	10	"	$CuSO_4$	40	1.2	1.0	Good Concentrate but not enough.	98	54.91	20	43.60		5.09	65.0

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Test No	OIL No.	OIL Amt. Drops	OIL Kind	REAGENTS Kind 1.0%	REAGENTS Amt. cc	Pounds $CuSO_4$	Pounds Oil	REMARKS.	RESULTS Conc. Wt. gm.	Conc. Per Ct.	Mids Wt. gm.	Mids Per Ct	Tail Wt. gm.	Tail Per Ct	Per Ct. Ext.
7	A.T.	10	Newport Chem. Wks.	$CuSO_4$	50	1.5	1.0	Good Concentrate	120	57.91	27	43.30	–	2.10	83.0
8	A.T.	10	"	"	60	1.8	1.0	" "	130	58.74	25	40.92	–	1.31	88.5
9	A.T.	10	"	"	70	2.1	1.0	" "	130	58.33	27	39.16	–	1.40	88.0
10	A.T.	10	"	"			1.0								
	15	2	Pine Oil	"	40	1.2	0.16	Good Conc. Better froth than with A.T. Mixture alone	124	57.91	12	41.14		2.80	78.5
11	X.Y.	10	Newport Chem. Wks.	"	30	.9	1.0	Fairly good Conc. More froth than A.T.	72	56.05	42	43.01		5.21	60.0
12	X.Y.	10	"	"	40	1.2	1.0	Good Concentrate but not enough	94	57.81	31	45.79		4.03	70.0
13	X.Y.	10	"	"	50	1.5	1.0	Good Concentrate	120	58.22	14	44.34		2.75	78.0
14	X.Y.	10	"	"	60	1.8	1.0	" "	128	58.64	32	38.44		1.31	89.0
15	X.Y.	10	"	"	70	2.1	1.0	" "	150	57.08	17	26.31		1.22	92.0
16	A.T.	5	"				.5								
	X.Y.	5	"	"	30	0.9	.5	Poor Concentrate Not enough $CuSO_4$	No Analysis						
17	A.T.	5	"				.5								
	X.Y.	5	"	"	40	1.2	.5	Better Concentrate	97	58.64	48	43.60		2.78	81.0
18	A.T.	5	"				.5								
	X.Y.	5	"	"	50	1.5	.5	Good Concentrate	112	54.49	13	36.36		4.23	70.0
19	A.T.	5					.5								
	X.Y.	5	"	"	60	1.8	.5	" "	138	58.74	18	37.40		1.11	91.0

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Test No	OIL No.	OIL Amt. Drops	OIL Kind	REAGENTS Kind 1.0%	REAGENTS Amt. cc	Pounds $CuSO_4$	Pounds Oil	REMARKS.	RESULTS Conc. Wt. gm.	Conc. Per Ct.	Mid. Wt. gm.	Mid. Per Ct	Tail Wt. gm.	Tail Per Ct	Per Ct. Ext.
20	X.Y.	10	Newport Chem. Wks.	$CuSO_4$	60	1.8	1.0	Good Concentrate	132	58.94	27	40.40	–	0.97	92.0
21	H.T.	10	"	"	60	1.8	1.0	" "	124	59.36	22	47.96	–	1.61	87.0
22	H.T.	10	"	10.0% "	10	3.0	1.0	" "	120	59.16	26	41.75	–	2.1	85.0
23	H.T.	5	"	"	20	6.0	.5	" "	150	58.64	12	32.33	–	0.58	95.0
24	H.T.	5	"	"	20	6.0	.5	" Check on No. 23	148	58.64	14	31.50	–	0.61	95.0